RS-INT
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(x-ME, BBEF Timber Estimate)

March 7, 1939.

MEMORANDUM

RELATIONSHIP OF NUMBER OF TREES AND VOLUME IN 10-11" D.B.H. CLASS TO TOTAL NUMBER OF TREES AND VOLUME IN STAND 10" AND LARGER.

The purpose of the analysis is expressed in the title: to determine the numbers and volumes of trees in the 10-11" d.b.h. class, and the proportion of the total stand therein. Since the relationship might be expected to vary with species, types, age classes, locations, history of stand, and other elements, it was desired to find which of these factors are of importance and whether it is practicable to derive or use any "standard" expression of the relationship for any given set of timber survey data. The analysis is confined to the ponderosa pine and associated Douglas fir types of central Idaho.

The application of such information is in the "conversion" of stand and stock data between a "10-inch-and-up" basis and a "12-inch-and-up" basis. Practically all of the studies of this Station and some previous work have set the lower limit of "merchantability" or sawlog or timber trees at 9.6" d.b.h., even tho it was known that trees of this size are never cut for lumber in this region. That division point is of some advantage, however, in representing close to the zero point of board-foot volume for a tree of average height according to the volume tables based on Scribner Decimal C rule generally in use. A substantial portion of the administrative timber survey data for this region and nearly all compiled and reported data for other western regions use a lower limit of 11.6" (i.e., 12-inch-and-up basis) for sawlog volume. For the purpose of comparing results of studies presented on the 10-inch-and-up basis with all these other stand data, it seemed worth while to determine and express the relation between the two. It is of course possible with complete stand tables to compute and report results on either or both bases in given instances, but in other cases full data are not available or perhaps a rough knowledge of the difference is sufficient, saving the additional computation and complexity of presentation.

Procedure.

The Bannock Creek Division of the Experimental Forest timber survey data were analyzed first, as representing virgin forest. Number of trees and volume in 10-11" class and total 10" and up were listed by compartments, type-ages, and lots (Sheets 1 to 19); data from original tally sheets and letter-size lot summaries. Totals for each type-age within each compartment, and for compartment as a whole were computed. Pine and fir and both species together were listed in separate columns throughout this and subsequent steps.

Summaries (Sheets 20 to 24) were then made of the group totals from each of listing sheets, and per-acre values computed for each type-age within each compartment and for the entire type-age on the area; also compartment totals for all types together, and totals for all ponderosa pine types and all Douglas fir types. Arithmetical means are listed for many groups (obtained by dividing group totals by number of items therein, regardless of acreage), but weighted means (obtained by dividing by acreage) are shown in most cases. Percentages (Sheets 25-26) were computed to show proportion of 10" number of trees and 10" volume out of total in each group.

For the PP/OM type, which was represented in every compartment, the number of trees in 10" class* was plotted over total number per acre (Graph No. 1). It seemed to show sufficient trend to warrant computation of regression (Sheets 27 to 29). The straight ruled lines on Graph 1 are the computed regression lines. Similar data were plotted for other type-age subdivisions (Graph 2), but they showed wide variation from the PP/OM values and among themselves, so that regressions were not computed. It should be noted that in the computations for PP/OM type, the unweighted means per acre were used to avoid the difficulty of weighting by acreages in the statistical analysis. The weighted means are very little different in this case.

Since pine and fir showed distinct trends (see Graph 1), and there was a wide variation in percentage of fir in the total stand in the different compartments, there seemed a possibility of relationship between number or

* The 10" class, as referred to hereafter, includes trees 9.6" to 11.5" d.b.h.

proportion of trees in the 10" class and the proportion of fir in the stand. Sheet 32 and Graph 3 were prepared, but there appeared such a lack of trend that this lead was not followed further.

The standard deviations of the percentages of number of trees and of volume for each and both species, PP/OM type were computed (Sheets 30-31). The regression computation had shown that the relation was best expressed with the addition of a constant to the percentage factor for number of trees, but if a straight percentage should be considered close enough, it is of interest to have an idea of the expected variation. The amount and proportion of volume were found to be so low that any refinement of relationship that might be discovered by regression analysis was considered impracticable.

One other virgin forest unit was analyzed: the Big Pine Creek permanent sample plots (Sheet 33). No assembled data on volume by diameter classes were available, so that only the number of trees per acre and proportion in the 10" class were computed. The Poorman Creek plot with its subdivisions was not included. Variation by individual plots was not listed or analyzed, so there is only one set of figures for the 11 plots (plot #13 omitted).

Each major type-age-site subdivision or other recognized division of the following cutover areas was treated as a sample and numbers and proportions computed as for the Bannock Creek unit: Pine Creek sample plots (each plot, one unit, but total used as one sample in grand summary); Pine Creek State Land; Clear Creek Government and Private Lands; Pearsol Creek; Lowman; Rock Flat. Inspection showed wide variations in Sapling types sampled, such as to preclude computation of any usable figures for this age-class. The P(pole) classes also varied widely, as might be expected, so it is probable that no "averages" can be used, unless further defined by actual age, etc. The mature and over-mature classes (code numbers 4-5, or over 120 years) were essentially similar in numbers and proportion, and the few samples available for immature (code 3, or 80-120 yrs) class did not differ widely so were grouped with the former for analysis. Fir and Pine types were segregated. Minor species were included

with Douglas fir in the "fir" columns. Per-acre numbers and volumes and percentages were relisted on Sheets 47-48, totalled and averaged for all cutover samples (unweighted averages). Standard deviations for each item were computed (Sheets 49-54).

Results and Conclusions

In general, the results were less encouraging than had been hoped for, especially in the direction of deriving any "universal rule" that would apply to all virgin or all cutover stands, for instance. In fact the numbers, volumes, and proportions for even a single species (or all species) in a given type-age class were so variable that it might be said "there is no average". Atleast the results do not warrant publication or suggestion of general application. It is worth while to know something of the values and their range locally, however, and considerable use may be made of them in connection with reporting and interpreting results of Experiment Station studies. As to the existence and use of such conversion factors as were computed, the following conclusions may be stated:

1. Different factors should be used for pine and fir types; the numbers of 10" ponderosa pine trees, their volumes, and proportions of total are all smaller in fir types than in pine types; but the numbers, volumes, and proportions of 10" fir trees and of all species together are much larger in fir than in pine types. (The proportion of fir numbers was similar or lower in virgin fir types in Bannock Creek, however.)

2. The same factors may be used for Mature and Overmature age classes (the field distinction of these two is not clear-cut in many cases anyway). The data were inadequate to show conclusively whether a separate factor is required for Pine/Immature (80-120 yr.) age class; it appears not greatly different from the M-OM; there might reasonably be considerable variation with specific age within this class. For such data as were obtained for DF/IM type, distinctly higher values of factors were indicated. The relationships for the Pole age class (40-80 yrs.) vary so widely with specific age, degree

of mixture of scattered older trees, etc., that no general average factors could be used. The same is true of Sapling class, which strictly would not have any trees 10" and up, but often shows some in tally because of scatttering of older trees.

3. Data were not segregated by site class in all cases, but inspection of such as were classified on this basis indicated that there was no definite trend of factor values with site quality. There may be some slight relation, as suggested by the fact that in even-aged stands of most species the distribution of diameter classes varies with site, but for present purposes it is impracticable to recognize it.

4. If possible, different factors should be used for pine and fir species; they vary significantly and greater accuracy will be obtained if the two are computed separately. The relationship is different in pine and fir types, as stated in paragraph 1. Average factors for all species may be used if no segregation is available, however.

5. Different factors must as a rule be used for virgin and cutover areas. Altho in many cases the absolute numbers and volumes in the 10" class are not greatly different (because few trees in this class were cut); the percentages normally are higher, for obvious reasons.

6. The analysis for the PP/OM type in Bannock Creek (virgin) by compartments (140 to 300 acres each) suggested that the use of a constant"conversion factor" would yield estimated values that were reasonably acceptable. (Standard error of estimate for numbers of trees was about 33 percent of mean.) The only other virgin stand, Big Pine Creek plots, showed values considerably different, but still within expected limits, using the Bannock Creek factors. This was an unsatisfactory check, however, as the Big Pine Creek plots include an unknown but fairly large porportion of Douglas fir type or at least semi-fir type. There is therefore no adequate basis for judging whether common factors might reasonably be used for virgin PP/OM (or MM) type in different general locations thru the region.

7. The numbers and volumes of 10" trees and their proportions all vary so widely between different cutover areas and even between type-age-site divisions of an area that the use of any common average or factor may give estimates that are far from the truth. (No regressions were computed, but standard deviations of various numbers, volumes, and percentages ranged from 39 percent to 132 percent of the averages.) Altho the use of average relationships or values for 10" trees may still be better than failing to consider any difference between 10-inch-and-up stand and 12-inch-and-up stand, it appears that the main use of the computed values will be in connection with each individual unit.

8. The computed numbers, volumes, and percentages which may be usable or at least of interest for comparison, are to be found on Sheets 20-29, 33, and 34-46 (with summary of latter group on 47-48). For proper interpretation, any "average" value should be considered in connection with its standard deviation, or the standard deviation of items in a similar group. The calculation of these is given on other sheets. Weighted means should generally be used where they are shown. A complete summary of factors was not prepared because some of them are obviously of no general application, and each should be viewed together with its source data.

9. In case these factors should be applied to other than units for which they were computed, the average proportions (percentages) will usually give closer estimates than average absolute numbers or volumes. (As was noted above for Bannock Creek compartments, the relation may be more accurately expressed as a combination of a percentage and a constant, but such refinement is probably not justified for practical purposes.) To give an approximate idea of these proportions and their variations, some of the gross average values for Mature-Overmature age classes are given in the following table: